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satellite" (1866·3). This is one of the pairs excluded by Otto Struve in the Catalogue of 1850. I see the companion now, although not without some difficulty. In the Catalogue of 1843 the magnitudes are 7, 10, and distance 12″. I do not know of any measures of the position-angle. It is very nearly preceding, or about 270°, and is certainly much smaller than 10 of Struve's scale.

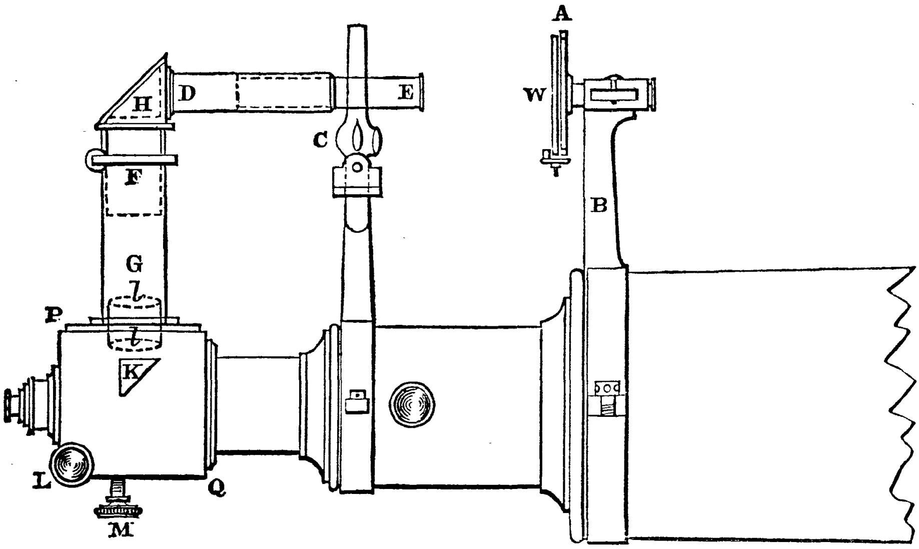
Chicago, 1874, *May* 17.

On a New Form of Position Micrometer.

By G. P. Bidder, Esq., Q.C.

The accompanying diagram represents a form of position micrometer, designed more particularly for the measurement of faint objects.

The principle of its construction is to throw into the field of view, by means of reflectors, the image of illuminated wires; so producing the appearance of bright wires on a dark field. For purposes of differential measurement, this arrangement affords many advantages over the ordinary dark field micrometer (in which the wires placed in the field are illuminated by side-light), and is, I believe, greatly superior in the measurement of faint objects.



The micrometer, A, which only differs from the common position micrometer in having no eyepiece before the wires, is placed above the telescope, and attached to it by a firm support, B. The wires, W, are illuminated by a lamp, C, in front of them, which is carried on an upright rod attached to the telescope, and is

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made capable of being shifted in height and inclination as may be required in order to throw the light on to the wires.

Opposite the wires is a tube, D E, parallel to the telescope, which excludes stray light. A diaphragm at the end nearest the wires reduces the aperture, and assists in effecting the same object.

This tube is attached to a short tube at right angles to it, which fits into the tube F G. This last tube is perpendicular to the axis of the telescope, and is fixed to the square box, P Q, forming a prolongation of the telescope draw-tube. At the intersection of the axis of the two tubes, D E and F G, is placed a rectangular prism, H, and within the tube F G a pair of convex achromatic lenses, *l l*. Below these is a second rectangular prism, K, so placed as to be above the cone of rays passing from the object-glass to any point in the field of view. The light from the wires being thrown by reflexion at the first prism on to the lenses, these form an image of the wires, which, by adjustment of the position of the lenses, is made after reflexion at the lower prism to coincide with the principal focus of the object-glass.

The distance from the wires to the lenses being greater than from the lenses to the focus, the image is reduced in size (in my micrometer the linear dimensions are $\frac{2}{9}$ of the dimensions of the wires themselves). By this means great delicacy of measurement is obtained.

The wires are seen in the field side by side with the stars to be measured, and may be superimposed upon them, but, being mere images, cannot hide them. The light can of course be reduced until the wires are scarcely visible. In the case of excessively faint stars an additional contrivance may be employed, by the help of which the faintest visible objects can be measured. It consists of an opaque bar fixed across a short tube, and inserted at the end E of the tube D E, and as near as conveniently may be to the wires. The bar is placed in such a position as to be transverse to the measuring wires. The effect is to intercept the light from a portion of each wire, and so produce a dark gap in the image of each. The image of the wires being moved in the field so that the stars to be measured appear in these gaps, they can then be readily measured. The lower prism is so mounted that by turning the screw-heads, L M, it can be tilted or turned in any desired direction, by which means the image of the wires may be moved to any part of the field. The whole instrument is so arranged that the screwheads of the micrometer are within reach of the observer while the eye is at the eyepiece.

By the interposition of coloured glass between the lamp and the wires they may be coloured with any desired tint.

It is essential to the accuracy of the measurements that the position of the micrometer and of the lenses, and the distance between them, should not be varied when once adjusted.

I am indebted to Mr. John Browning, who has made my instrument, for the admirable manner in which he has carried out

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my design. The instrument, so far as I have hitherto tried it, fully answers my expectations.

A plan somewhat similar to Mr. Bidder's for using a "ghost" of the wires instead of the wires themselves, but applied to a meridional instrument, is described by M. Karl v. Littrow, in the *Proceedings of the Academy of Sciences*, Vienna, Vol. XX., for 1856. M. Littrow uses intercepted wires in the same way as in Mr. Bidder's contrivance.—Ed.

On the Fixing of Spider-lines in Collimators and Transit Telescopes.

By Capt. John Herschel, R.E.

Some time ago I had occasion to replace some broken wires in the diaphragm of a transit telescope. As it is an operation which every practical astronomer ought to be able to perform for himself—more especially when on foreign duty—and as there *are* difficulties about it which may be lessened by reading an account of a similar operation, of a rather unusual kind, as actually performed, I will endeavour to recall what I can recollect of it.

I may preface this particular account with one or two general remarks upon the subject.

The occasions upon which skill in wiring diaphragms may be brought into play with advantage are so numerous, that it is well to take advantage of every opportunity to put whatever may exist into practice, with a view to prepare for cases of emergency. It does not always happen that the wires of a collimator, for instance, are adapted, in thickness and angle, to the use to which they are to be put—in which case it is very convenient to be able to replace them readily. On foreign service, too, the liability to disfigurement or fracture is much increased; and if confidence has been acquired, a few hours' work at the right time will save much annoyance later. The case I am about to describe was so prefaced, fortunately, by many lesser experiences.

My next remark has reference to ways and means. There are often many ways of doing the same thing, and these often depend on the means at hand. It will be seen that mine were not of an out-of-the-way kind. Such as they were, they sufficed, but possibly others would have served equally well. Some implements, however, are almost essential; for instance, a camel's hair or sable brush—better still, two or three; a lump of beeswax; a few corks, and a few carpentering tools and materials are also useful. Some sort of varnish, too, is necessary—I always use shellac—and some spirits of wine.

The diaphragm upon which I operated was one cut for 25 wires in 5 tallies of 5—the whole occupying about one-third of an inch—on the longer sides of a rectangular plate or frame